TROPICAL AGRICULTURE

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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

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TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E. C. 3, England. The Editor will be glad to consider authoritative articles for publication. It is understood that opinions expressed in signed articles are those of the author and do not necessarily represent the policy or opinion of the College Authorities. Increasing numbers of inquiries are being received from various parts of the tropics which can be answered only by persons possessed of an intimate knowledge of local conditions. Enquirers should first satisfy themselves that their local Department of Agriculture is not able to supply them with the desired information before communicating with us. Correspondence which will be replied to is invited on all other matters pertaining to tropical agriculture, science and development.

INDIA AND AGRICULTURAL DEVELOPMENT.

WE publish on another page a condensed report of Lord Irwins' address to a meeting, which was attended by the Ministers for Agriculture, the Agricultural Adviser and all Directors of Agriculture from the Provinces of India. The meeting was called to discuss the procedure of the Royal Commission on Agriculture, which is to visit India in the coming cold weather. The task of the Commission is a severe one. It has "to "report on the present condition of agriculture "and rural economy in British India and to "make recommendations for the improvement of "agriculture and the promotion of the welfare and "prosperity of the rural population." The task would be wider than it is, but that the question of land ownership and tenure, revenue assessments and irrigation charges are specifically indicated as subjects which are excluded from the cognisance of the Commission. This exclusion is, perhaps, unfortunate, but its reason is obvious. In India land revenue is a fundamental item on the credit side of the Government's budget. In India, more markedly probably than elsewhere, has Government retained a direct share in the profits derived from the soil and the partnership is triple, Government, landlord and tenant. To have included the subject of land revenue would not merely have thrown open to the Commission the fundamental basis of Indian administration, but would have rendered the subject of investigation so vast, that any report within a reasonable period would have been out of the question.

The reasons for the exclusion of the question of land tenure are not so obvious. Systems of land tenure—that is the division of the profits as between landlord and tenant—are of fundamental importance to agricultural development, and it is hard to see how the commission, debarred from taking cognisance of this subject, can produce a really valuable report. Recent tenure legislation has taken the form of protection of the tenant against the results of competition for available land. The protected tenant tends to become landlord, the landlord tends to become a mere rent collector and the fundamental problem of an impoverished cultivator remains. It is true the Commission is particularly instructed to investigate "the method by which agricultural "operations are financed and the credit afforded "to agriculturists" and "the main factors affecting

" rural prosperity and the welfare of the agricultural " population," but it is difficult to see how such matters can be reported on adequately, when the subject of land tenure, on which they rest, is excluded.

Over large sections of India the 'zamindari' system—a system of large holdings—holds good. It is true of Bengal with its permanent settlement, where land, owing to the limitation of the Government's demand, has formed the basis of speculation; and it is true of large areas of Northern India even where settlement is for a limited period. In these cases the true source of capital is the landlord and the problem is to draw him out of his position of the " sleeping partner " who reaps without effort his portion of the unearned increment. Yet this aspect is excluded; and the Commission is limited to the consideration of co-operation which, vital though it is to those tracts developed on the 'rayatwari' system—a system under which the actual cultivator is the direct owner under Government—is of partial application only in 'zamindari' tracts.

The really important function of the Commission is defined in the first of the duties to which particular attention is directed:

" To investigate the measures now being taken " for the promotion of agricultural and veterinary " research, experiments, demonstration and " education; for the compilation of agricultural " statistics, for the introduction of new or better " crops and for improvement in agricultural " practice, dairy farming and the breeding " of stock."

Of these, education, in as far as over 70 per cent. of the population are directly dependent on agriculture, is divided between the Agricultural Departments and the Departments of Public Instruction; the former being responsible only for the technical agricultural schools, the question of primary education among the cultivators being the function of the latter. Agricultural statistics also form a subject only partially under the purview of the Agricultural Departments. With these two exceptions the function of the Commission, as defined, is to review the work of the Agricultural Departments and to make recommendations for the better fulfilment of their functions.

The Agricultural Department of India was organised nearly a quarter of a century ago. Before that, it is true, there were certain isolated posts held by technical officials, but there was no co-ordinated effort of service. That co-ordination was the outcome of Lord Curzon's administration and from that time there has been a rapid expansion. The Pusa Institute, with an estate of over 600 acres, was initiated in 1904 and in 1924-25 cost over £60,000; the various local Departments show a net expenditure of some 74 lakhs of rupees, the equivalent of over £525,000. Yet this organisation is the subject of a Royal Commission which is to investigate measures and recommend improvements. What, we would suggest as a subject worthy of investigation, are the corresponding amounts spent on similar services in the rest of the Imperial Tropical dependencies? It is a question that would be difficult to answer, especially when nett figures are under consideration. The question is more readily answered when the subject of research is considered. Tropical Agricultural Research on an Imperial basis is, in its widest sense, limited to a few Institutions. The Imperial Institute receives certain sums from the tropical dependencies but carries out for these work other than agricultural; the two Bureaux of Entomology and Mycology cost some £12,000 part only of which comes from tropical dependencies and finally there is the Imperial College of Tropical Agriculture with an annual nett expenditure of £21,000, a sum which not only covers the cost of research, but of a full educational course of University status and a largely attended post graduate course. It is the sum of these amounts which offers a rough comparison with the sum of £60,000 spent annually on the Pusa Research Institute, an Institute which is practically limited to research. Can it be doubted that the amounts spent on Imperial Agricultural Research are far from adequate and that the subject of such research is still more worthy of an enquiry such as is considered necessary in India? There is a yet more difficult subject of enquiry. India is an administrative unit, the tropical dependencies are not. India, owing to its relative wealth has been in a position to organise a service such as no single dependency can afford to carry. The finance necessary to establish an effective research organisation for the remaining tropical portions of the Empire can only arise from co-operation among the different units.

ST. VINCENT.

A correspondent of the *Times Trade and Engineering Supplement* in a short article on arrowroot, expresses the opinion that the emphasis which had been laid upon its purely medicinal value has tended to restrict its consumption. The fact is not generally realised that this unique Empire food is eminently suitable for inclusion among household commodities for everyday use. The only supplier on a commercial scale of this valuable food is the small British West Indian Island of St. Vincent, which exports annually from two million to five million pounds. Arrow root custard and arrowroot blancmange are said to be infinitely superior to similar articles made from cheap foreign starches. It can also be used in gravies, soups, and pastry. The representative of the St. Vincent Arrowroot Growers' Association in the United Kingdom is Mr. Ernest Brown, of Messrs. Dawson, Shores, Punch & Co., Ltd., 7, Mincing Lane, London, E.C.3.

COLOMBIA.

The following notes have been received from Mr. R. Parga, a former Post-Graduate Student of the College, who has purchased a coffee estate in the Tolima Department of Colombia. In his covering letter he states that it is impossible to speak in terms other than optimistic of the future of the Republic which is now politically and financially on a sound basis. Progress hitherto has been very slow and confined almost wholly to the efforts of the native Colombians but now the country is clamouring for a more rapid development and granted the necessary capital and, later, population, progress should, in his opinion, become rapid.

COLOMBIA has by now completely recovered from the depression caused by the world-crisis of 1922-23. At that time an American financial mission was advising on the reform of the country's finances and acting on their advice the Banco de la Republica was established with the Government owning a large majority of the shares. In the future this bank will alone have the right to issue notes, which will be safeguarded by a large gold reserve. For three years now the Budget has been balanced and the Colombian peso stable at par with the dollar.

The great problem of the country is the difficulty and expense of transport. Railways and roads are very costly to build owing to the mountainous nature of the country, whilst the Magdalena River, the chief artery of trade, becomes in the dry season almost innavigable in parts owing to its width. The Government has just signed a contract with the great German firm, Julius Berger Consortium, to canalise the river so that at all times of the year navigation will be possible for shallow-bottom boats. The company had previously presented detailed plans and hopes to complete the work in three years. At the same time an American company is opening the bar at the mouth of the river to allow ocean-going boats to come up to Barranquilla. The Government is also making a great effort to build roads and railways, and claims that in public works—railroads, roads, improvement of the waterways—it is employing 25,000 men. The Departments are also constructing roads and in some instances railroads.

The Government is quite alive to the fact that our condition must always be somewhat precarious whilst 75 per cent. of the value of the total exports of the country is due to coffee and is investigating the growing of other crops on a large scale. A mission from the International Cotton Association, composed of Messrs. Arno Pearse and Arthur Foster of Manchester, has just visited the country to investigate its cotton-growing possibilities. They intend to publish a book at the end of the year, but found in several Departments good native strains and appropriate conditions.

Agriculturists are expecting much from the recently-created Agricultural Mortgage Bank in which the State is the chief shareholder. The Bank will issue Bonds at home and abroad which will be guaranteed by the State. The first issue of $3,000,000 7 per cent. Bonds was recently made in New York. They were offered at 94 and were totally subscribed in two hours.

The prospects at the end of the past year were very promising. The revenue not only of the Central Government but of most Departments had greatly increased and a revenue of $1,500,000 was entering the National Treasury each month. The coffee crop of 1925 had not been as good as that of 1924 owing to adverse climatic conditions, but this was in part compensated for by better prices. The exports were : in 1924, 2,200,000 bags valued at $68,000,000 in 1925, 1,950,000 bags valued at $66,000,000. The flowering of the 1926 crop had been very good and everything pointed to the probability of a record crop. Since then, however, the country has experienced one of the worst droughts on record. Most of the crops have been lost and the river was almost innavigable for a month or more. Probably 25-30 per cent. of the coffee crop has been lost and in some parts much more. The drought seems at last (1st May) to have broken, but the Government intends to import foodstuffs for the men employed on public works to save the situation.

AFRICAN AGRICULTURAL DEVELOPMENT AND THE AEROPLANE.

IT is interesting to note Mr. Alan Cobham's views as regards the possible use of the aeroplane in Africa, as indicated in an interview reported in *The Spectator*, for 27th March, 1926. Mr. Cobham has recently returned from a flight from the Cape to Cairo. He maintains that a daily air service could satisfactorily be established from Cairo to Khartoum, Kenya and Uganda. By means of land-planes or sea-planes, it would thus be possible to get mails through to Central Africa in seven days instead of a month as at present.

As regards North Rhodesia and Tanganyika, he considers there are great possibilities for an aerial survey in relation to tsetse-fly control. By aerial photography, the forest zones could readily be located. These zones could then be cleared by fire, and tsetse-fly thus isolated.

Mr. Cobham considers that a mail service should be established in Central Transvaal, say from Johannesburg, Kimberley or Pretoria to Walfish Bay. This route would save seven days on mails to London. The Chamber of Mines in Johannesburg ships enough gold to England for the floating interest on it to amount to £6,000, if only one day in the week were saved on the mail time. If six days a week were saved, the figure becomes £36,000 a year from that source to help out commercial aviation. Mr. Cobham further suggests that every farmer in South Africa should possess an aeroplane, The whole country is a vast aerodrome, and the visibility is excellent. Aeroplanes can land anywhere, except in Natal. He holds that the farmers are sufficiently prosperous to be able to afford aeroplanes, and to use them in their business and pleasure.

ROAD TRANSPORT IN AFRICA

And a note on the Experiments of the Empire Cotton Growing Corporation in Nigeria.

BY COLONEL C. N. FRENCH.

THE importance of and the need for better transport facilities in Africa have been recognised for many years, but the question has not been investigated as continuously and scientifically as it deserves, and the issue has, consequently, been confused by the number of self-styled experts each with their own theories as to the best solution of the problem.

Of all forms of transport it is generally admitted that railways are the best, the most reliable and, provided the amounts carried are considerable, the cheapest, but, in the present stage of African development, they cannot be built except as arterial lines, and the secondary problem connected with transport in the Continent is to discover methods by which they can drain the largest possible areas of country on either side of their length, or in other words what are the best forms of feeder transport.

This paper aims only at describing one of the methods by which railways might be supplied with increased quantities of produce, provided that "half-track" vehicles, such as are described below, can be brought to a greater state of perfection than is the case at present.

Hitherto primitive methods such as ox-wagons, pack animals and even head porters have competed successfully with modern forms of transport, because production has been small and the supply of transport animals or men has been equal to the demand and therefore cheap, and also because, generally speaking, manufacturers of motor vehicles have not saturated their home markets and consequently have not paid much attention to the needs of the Tropical African market, where the best roads are rough and the native drivers rougher and where repairing facilities are few and generally inefficient. Where native drivers are employed the rate of depreciation of motor vehicles is very high and, therefore, a satisfactory car or lorry must be strong and simple, or, in other words "fool proof." In addition the high cost of petrol (owing to freight charges) makes motor transport very expensive. Internal combustion engines for Africa should be made for paraffin, while there should be a future for producer gas or locally manufactured alcohol, if they can be perfected as propellants. The actual cost of creating and maintaining an efficient motor transport service is, however, only a part of the problem. Another very serious consideration is the high cost of making and maintaining roads which are suitable for and can resist the wearing effect of heavy vehicles. A system of roads, even such as existed in England 35 years ago would be impossibly costly in Tropical Africa, while African road makers can hardly be expected to realise the disintegrating effect of intensive motor traffic on the best of modern roads, although even now many of their roads have had to be practically remade after a short life, owing to the wear of a few cars and lorries and the scour and erosion caused by tropical rain storms.

The road transport or railway feeder problem cannot, therefore, be considered in two watertight compartments of vehicles or of roads but must be tackled as a single question. The effect of vehicles on roads must be studied as carefully as the effect of roads on vehicles, and the combined capital charges must be taken into calculation if Tropical Africa is to be opened up. The problem is one which might be compared to that which would have arisen if 20th century vehicles had been introduced on English 18th century roads.

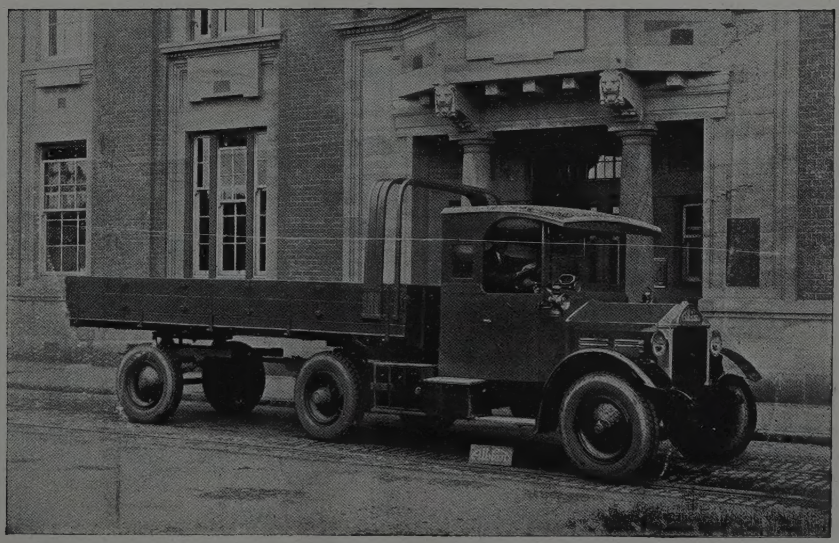
Another aspect of the problem is that, since African exports are mainly agricultural, about 80 per cent. of the heavy road transport is seasonal, generally taking place during the dry months and therefore, although the effects of rain storms, which are the worst enemies of the road maker in many parts of Africa, must be guarded against, it may be found in practice that a road built for purely commercial reasons will not require the same amount of bridging and culverting as is necessary on an administrative or strategic road used throughout the year. This aspect of the road-making side of the problem must of course be considered locally and the question as to whether bridges, culverts or paved fords are preferable must be decided on the merits of each individual case. Where, however, a road is required for seasonal traffic during the dry months of the year there would seem to be greater advantages in using a vehicle which can travel on and perhaps improve an "earth" road and which can also carry or pull a load large enough to be reasonably economic.

Since there appears to be some doubt about the matter it may be well to state here that what is meant by an earth road is one which has been graded as carefully as possible (for easy grades are more essential than direct routes) and which has been cleared of trees and stumps for a width of at least 30 feet. Such roads are being made at the present time all over Africa, generally under the direction of administrative officers; they cross streams by cheap bridges, culverts or paved fords and are remarkably cheap and on the whole very satisfactory. Transport on these roads presents a wholly different problem from cross country transport which is an impracticable proposition in most parts of Tropical Africa.

Finally, it must be remembered that an African road system must be extensive. The great mileage required precludes the possibility of really high class roads. The population to the square mile is very small and generally speaking there is nothing that could be described as continuous cultivation. The fields, cultivated by the natives, are scattered through large areas of bush and intensive cultivation is found only where there are white planters many of whom develop their plantation transport with such systems as monorails, &c.

Road Transport in Africa.

11.4 H.P. CITRÖEN-KEGRESSE CAR.
(By permission of Messrs. Citröen-Kegresse, Ltd.)



24 H.P. TWO-TON ALBION LORRY.
(By permission of the Albion Car Co., Ltd.)

Road Transport in Africa.

25.8 H.P. BURFORD-KEGRESSE TWO-TON LORRY.

A TANKODROME IN FRANCE.

The sea of mud is the result of running unsprung laterally rigid tanks over a grass field. The effect of steering by skid is particularly noticeable. If these machines had been equipped with cable suspension and laterally flexible tracks the surface of the ground would have been smoothed and consolidated.

(By permission of Roadless Traction Co., Ltd.)

It will be obvious that for unmetalled earth roads, such as have been described above it is desirable that the weight on the axles of transport vehicles, or in other words the pressure per square inch on the road surface should be low. This reduction on the axles may be achieved by the following means :—

1. By using light vehicles.
2. By increasing the number of wheels.
3. By increasing the width of the wheel treads.
4. By enlarging the diameter of the wheels.
5. By substituting some system of caterpillar action or continuous track for wheels.

1. The possibilities of light cars, such as "Box Fords," were very fully explored during the late war, when they proved of the very greatest value from a military point of view. They are used to a very large extent at the present time in Tropical Africa, and there is no doubt that light lorries of this description are very useful, but they have their limitations. Their load is small, and each small load requires a separate driver: consequently the running costs per ton-mile are high. Moreover, they have not sufficient power to traverse sandy, boggy, or heavy ground. On the other hand, the engine-power, and therefore the fuel consumption, is excessive in comparison to the useful load. A 4-ton lorry drawing a 2-ton trailer requires one driver (and perhaps an assistant) in charge of a power plant of a nominal 35 h.p. or so. The same load of six tons distributed over the necessary number of 7-cwt. vans will need seventeen drivers, and, in the case of the Ford, seventeen engines of 20 h.p., making a total of 340 h.p. The capital cost of seventeen 7-cwt. vans is very much greater than that of one 4-ton lorry and trailer. The only justification for this greatly increased expenditure is that the light van can be used without the absolutely prohibitive outlay on roads demanded by the larger vehicle.

2. Reduction of axle weight by increasing the number of wheels is a common practice with railway vehicles, which are mounted on bogies; many large lorries or trailers also in this country are fitted with six wheels.*

The most elaborate development of this principle is a 13.5 d.p. Renault chassis, fitted with three axles, and six wheels: of these six, four are driving wheels, with two driving axles, each with its own differential. The arrangement of these wheels allows considerable freedom of movement, so that if one wheel passes over an obstacle, such as a stone, the other three remain in contact with the ground. Each wheel, moreover, is a twin, consisting of two rims bolted together, so the weight of the car is carried on twelve tyres, all of which are the balloon type. This car has been proved to have remarkable capacity for getting over ground where an ordinary motor car would be completely "stalled." The objections to it are the cost of the twelve large tyres, and the fact that, being a wheeled vehicle, its further developments appear to be limited; moreover, the wheels, although the weight on them is comparatively small, will damage a soft surface whenever they slip, and will not improve and consolidate unmetalled roads.

Another type of six-wheeler is the 24 h.p. 2-ton Albion Lorry supplied to the Crown Agents for use on the Gold Coast. Here the load is distributed over six wheels instead of four, which, making due allowance for the extra weight of the third axle, reduces the load on each wheel to about three-quarters of that in a four-wheeled lorry of similar carrying capacity. This type of lorry has, it is understood, been most successful.

3. Wide wheels treads are a normal feature of the modern steam tractor, but width of tread is useless beyond a certain point, because the wheel does not come into contact with the ground across its whole width.

4. The theoretical advantages of large diameter wheels with wide treads are found in practice to be neutralized by their excessive weight before they have reached any great size. The largest wheels actually used in practice are found on steam-driven traction engines, and the maximum is about 8 feet in diameter by 12 or 15 inches across the tread. Even then they are so heavy that they are only suitable for a traction engine which does not attempt to carry any load in addition to its own weight and a limited amount of fuel. There is another type of large diameter wheel which is used on the American buggy, or spider. The wheels are made very thin, and it is found in practice that their rolling resistance on rough, sandy, or soft ground is low, but little more than parcels can be carried in addition to the driver and passenger, as the wheels would collapse under a really substantial load.

Other types of wheeled vehicles include the conventional lorry so arranged that all four wheels are driven instead of only the two rear wheels. This type has been very successful up to a point, and is in fairly common use all over the world. But, however, the problem is considered, there is no escaping from the fact that a wheel with its small contact, however lightly it may be laden and however soft may be the tyre, will damage the surface of an earth road so soon as there is a slip between wheel and road.

(*To be continued.*)

* The latest six wheeled vehicle is a six wheeled Morris lorry. This can be converted into a half track lorry by attaching a belt to each pair of driving wheels. It has not yet been seen by the writer.

GIFT TO ROTHAMSTED.

At the annual inspection of the Rothamsted Experimental Station, Sir John Russell, the Director, announced that the Rockefeller Trust Committee had promised £2,000 towards the cost of erecting accommodation for the study of plant diseases and pests.—(*Journ. Soc. Chem. Indus.*, 2nd July, 1926, p. 455.)

AGRICULTURAL NOTES.

COMPILED BY THE COLLEGE DEPARTMENT OF AGRICULTURE.

Milk Goats.

THE British Goat Society's Year books for 1925 and 1926 are replete with useful hints for goat-keepers and those contemplating a start with goats. The price is 1s. 6d. each; further information may be obtained from the Secretary, 10, Lloyd's Avenue, London, E.C. 3.

A typical article on selecting a goat is reproduced herewith :—

"It is quite easy to get a goat, but needless to say there are goats and goats, just as there are good, bad, and indifferent in all walks of life.

Looking back on the last twenty years I find most people desire an animal that will give satisfactory results for the time, trouble and cost, also at any time saleable and whose progeny is worth rearing.

The first consideration is health and vigour. Under no circumstances, however, cheap or even as a gift, have anything to do with an animal that is not perfectly healthy and in good condition. See that there is complete physical fitness. The alert, active goat is what is required, entirely free from glands and any deformity.

Type comes next, and here one must remember that the various internal organs must have a sufficiency of room to perform their various functions properly and turn the raw material into the elements which are needful for the animal. The body should have depth, width, and be well ribbed, the chest wide, giving heart and lung room. Avoid beefy, heavy shoulders, long in the leg, slab-sided, narrow-chested and narrow gutted animals. The neck and head should show fineness and quality, likewise the skin and hair. Breed and colour are simply a matter of individual fancy. The udder is of great importance: see that it is silky to the touch, wide, and carried well under the body, with nicely placed teats; avoid the pendulous and narrow-necked udder.

Horned, dis-horned, dis-budded, hornless, is just a personal concern and convenience; aim for a goat that is well balanced—a large one, standing over 28 inches at the shoulder, yielding 16 lb. of milk per day; a medium sized one, standing over 24 inches and under 28 inches yielding 10 lb. or the small one under 24 inches giving 6 lb. Each one has a place in the scheme of things according to how much attention can be given and the depth of pocket. See that the goat is symmetrical. The bigger the yield the bigger the animal should be. One cannot make a success if an animal is all bag, neither if it is without bag, therefore, be sure that the udder and milk yield is in proportion to the size of the animal. The price—and that is where so many somehow get wrong impressions; one cannot in this world get a good thing for nothing or without some effort; there is no fixed price for any kind of animal and it is just worth what it will fetch. However, it is only fair to consider that the big goat with the high yield will cost quite £20 to produce; the small goat, though eating much less and not requiring so much attention cannot be reared under £5; in addition, surely the breeder is entitled to a profit. Occasionally one can come across a decent animal from a dealer, but here one must depend entirely on one's own judgment.

There are many reliable breeders and a certain amount of confidence can be placed with them, always remembering that pedigree is *not* everything Far better have the right kind of animal without a pedigree than the finest pedigree and a badly balanced animal. Many suggest purchasing kids. These no doubt, cost less, but there is the difficulty of rearing. Believe me, rearing kids well is not easy, neither is it cheap, also one never knows how they will turn out.

The safest investment is a goatling, provided you get a written guarantee that she will breed. You have got the animal reared, and when she comes into milk she will have become thoroughly accustomed to you and your mode of keeping, thus doing her best. Buying milkers, excepting to persons who are skilled, often ends in disappointment. Finally, my advice is:

Buy a goatling.
Physically fit, alert and active.
Good type, depth, width, well ribbed.
Quality of neck, head, skin and hair.
Well shaped and placed udder.

Symmetrical whether large, medium size, or small, and as good a milking pedigree as you can. You will then have an animal that will give you the utmost satisfaction and prove a good investment."

THE COCONUT INDUSTRY OF TRINIDAD.

MR. Preston E. James, Assistant Professor of Geography in the University of Michigan, contributes an article on "Geographic Factors in the Trinidad Coconut Industry" to the January issue of *Economic Geography*. He records that although coconuts were not included among crop acreages and production in 1838, coconuts were growing along the sandy eastern coast where nuts, drifting from the neighbouring South American continent had lodged and grown without any form of cultivation. By 1880 the beginning of a coconut industry had been made at the Cocal by the collection and preparation of nuts from self-sown trees. Owing to favourable conditions the industry extended southwards along the east coast almost to the southern coast. The industry has also tended to localise itself along the North Coast District including a number of isolated patches along the mountainous northern shore. The other

major coconut area is the Cedros District occupying the south-western peninsula. In addition there are plantations scattered widely over the island, some in favourable locations, but many in very poor situations and consequently in poor condition.

The main crops of the island are cacao and sugar-cane, the former occupying by far the largest acreage under any one crop. The existing large area under cacao is the result of a long period of prosperity but since 1920 prices have fallen to such an extent that producers have been faced with ruin. The price for coconuts on the other hand, has remained satisfactory with the result that some cacao planters have cut down their trees and replaced them with coconuts, frequently on soils unsuited to coconuts. Owing to the different requirements of the two crops cacao does not compete with coconuts in the sites best suited for the latter crop. Sugar cane cultivation has tended to become localised around the larger factories with the result that some small areas previously under cane have now been given over to coconuts.

A description is given of the methods of cultivation on Colombia Estate in the Cedros district. A study of the relation between rainfall over a six-month period and the size of nuts for the six-month period one year later reveals a correlation of $+.733 \pm .072$. The cost of production of 1,000 nuts during the first half of 1922 is given as \$13.22½ (\$1=4*s.* 2*d.*) the corresponding price being \$15.18. A comparison is made of Colombia Estate with other estates in the same district particularly Perseverance Estate where drainage problems present considerable difficulties. This estate is able to pay its way only on account of the intensive system of cultivation adopted and would probably succumb under the stress of a prolonged period of low prices.

The Cocal, in the Nariva-Mayaro district contrasts sharply with Colombia Estate. Essentially it represents a natural growth with a minimum of cultivation and scientific care, but under ideal natural conditions. Coconuts produced at the Cocal are practically forest products, and the natural conditions give high yields with little effort. The Cocal is located along Nariva Beach and is a long narrow strip of land, at no place over a few hundred yards in width, and many miles long, bordered by the ocean on one side and the Nariva swamp on the other. In places the waves are eating back the land. The soil on this sand bar is of a texture excellently suited to coconuts and the waters of the Nariva Swamp seep out through the loose sand, bringing a continuous supply of water, never stagnant, to the palm roots. The Cocal is exposed to the full sweep of the Trades the annual rainfall varying between 80 inches and 100 inches. The humidity of atmosphere makes sun drying of copra very difficult with the result that most of the copra is prepared by a steam drying plant. The heavy rainfall and large drainage area from which ground water is derived render this area much less dependent on differing amounts of rainfall than is the case at Cedros. Malaria is very common. The exposure of the Nariva Beach to winds and waves renders the landing of boats very hazardous with the result that the southern part produces chiefly copra and oil and the northern part copra only which are less subject to damage by heavy handling. Little or no artificial drainage is needed and as a result of the constant fertilization of the soil by natural processes it has been found practicable to use the coconut husks as fuel in the steam drying plant instead of returning them as mulch to the soil. The chief costs of production are those of picking, manufacture into copra or oil, shipment, and overhead costs so that while Colombia Estate was producing coconuts at about \$12.64 per 1,000 the Cocal was able to produce at the rate of about \$8.00 per 1,000. The production of coconuts has increased from 2,349,160 nuts in 1920-21 to 3,483,375 nuts in 1923-24, almost wholly as the result of greater care in picking and in gathering the fallen nuts.

In the North Coast District conditions are by no means as ideal as at the Cocal but by proper attention to cultivation and management the estates may be made to yield well. The heavy rainfall along this coast and the steep slopes of the coastal ridge combine to insure a good supply of ground water with a rapid flow. The winds blow parallel to the coast and the little swampy bays are protected from their influence, resulting in a steamy humidity and an abundance of malarial mosquitoes. Owing to the difficulty accessibility of the North Coast District by road the produce is usually sent by steamer. The cost of production is estimated at \$11.00 per 1,000 nuts.

Professor James suggests three stages in the adjustment of the industry to geographic conditions. In the early days coconuts were confined to the areas most favourably adapted by nature for their production. Rapid fluctuations and high prices have caused the extension of cultivation to lands normally unsuitable. The third stage will be reached when increasing economic pressure causes the industry to retreat from the poorer lands and increase production by a more intensive use of the better lands. The third stage is not near at hand in Trinidad.

C. Y. SHEPHARD.

WORLD CROP ESTIMATE.

THE United States Department of Agriculture estimated the world total beet sugar crops at 9,096,670 short tons for 1925-26 compared with 8,976,475 tons last year, an increase of 1.3 per cent. The cane crops were estimated at 17,915,000 tons compared with 17,662,000 tons last year, an increase of 1.7 per cent.—*The Planter and Sugar Manufacturer.*

TROPICAL CLIMATES.

Their Extremes of Temperature, Wind and Rainfall.

Dr. Stephen S. Visher of Indiana University, United States of America, has contributed an informative article to *Ecology*, Vol. IV, No. 1, on the subject of extremes of tropical climate. It is interesting to note some of his facts and conclusions, particularly as they have important bearing on crop-production in the tropics.

Most of the available data relating to tropical conditions are merely average figures. For this reason, many striking circumstances generally escape notice. The chief feature of tropical climate, namely, its extreme variability from year to year, from season to season, and from place to place, is rarely stressed.

1. *Variability in temperature.*

Although there is little seasonal contrast in temperature within the tropics, yet near the borders of the tropic zone, contrast is appreciable. At Hongkong (lat. 22°), for example, the normal differences between summer and winter temperatures is only 2°F. less than at London. Calcutta has a greater temperature-range between the three warmest and the three coolest months than has Dublin, and Brisbane and Cairo each have twice the range as San Francisco. Even in regard to temperature extremes, some tropical cities have nearly as great a range of extremes as have many temperate cities. Compare, for instance, the range between extremes of 64°F. at Calcutta with 74° at Dublin; 54° at Rio de Janeiro, with 58° at Wellington; 95° at New Orleans with 86° at Amsterdam, and 71° at Johannesburg with 90° at Sitka.

In temperate regions, the range of temperature between day and night is usually low. The nights are too short for maximum cooling in summer, and the days too short for maximum heating in winter. In tropical regions, on the other hand, the temperature range between day and night may be very high, because day and night are of almost equal duration, and because the rate of heat loss is greater during tropical nights. Night-time has been aptly termed the "winter of the tropics." Differences in humidity or aridity, moreover, may greatly enhance these tendencies. Thus, temperatures approaching freezing point are common in the arid tropics, and frost may occur there at moderate elevations, and even at sea-level in continental areas like Africa and Australia within 20° of the equator.

Tropical thunderstorms may cause another sort of temperature variation, amounting to as much as 6° or 8° F. within a few minutes. Hail-storms are not uncommon in the tropics. Ten hailstorms occurred in ten years in Northern Australia at latitude 13°-16°, and three in twelve years at Panama, at latitude 9°.

2. *Variability in wind.*

The wind is not a steady trade-wind all the time in the tropics. The nights are usually calm on the dry lowlands. Cyclones, dust whirl-winds, water-spouts and tornadoes are common. At least one hundred hurricanes occur somewhere in the tropics every year. There are also seasonal variations in the velocity of the trade-winds; they are half-gales at Fiji and many South Pacific regions in the spring months, and full-gales at the Philippines in winter. In other months, calms or light breezes are the rule, especially when the doldrums are migrating twice a year.

Land and sea-breezes are most marked in the tropics, because of the great contrast in temperature over land and water. The monsoons are a special type of land and sea breeze, for they blow toward the land for many consecutive weeks in summer, and toward the sea for as many weeks in winter. There may be a surface calm at night on lowlands, even where the monsoon is blowing strongly a few score feet above the surface.

3. *Variability in rainfall.*

In temperate regions, the highest recorded annual tainfall is rarely more than twice the lowest annual rainfall. In the tropics, however, the rainfall of the wettest year on record is never less than twice that of the driest year. Of twenty impartially-selected tropical cities, the lowest ratio is $2\frac{1}{4}$, for Calcutta and Caracas. For Johannesburg, it is $2\frac{1}{2}$; for Durban, Hongkong, New Orleans and Naples, $2\frac{3}{4}$; for Colombo and Honolulu, 3; for Bombay, Buenos Aires and Manila $3\frac{1}{2}$; Madras, $4\frac{1}{2}$; for Singapore, 5; and for Rio de Janeiro, $13\frac{1}{2}$. Each of these tropical cities has a normal annual rainfall of over 30 inches, and the mean for the group of cities is 55.6 inches, as contrasted with 30.5 inches for a similar group of temperate cities. Tropical cities therefore exhibit great fluctuations in annual rainfall. If tropical cities having normal average rainfalls of less than 20 inches are included, even more extreme ranges are disclosed. For example, Cairo and San Diego in California each received about $6\frac{1}{4}$ times as much rain in their wettest year than in their driest; Athens, 7 times; Helwan in Egypt, 18 times, and Onslow in W. Australia, 47 times.

None of the cities named, however, except Singapore, lie near the equator. Nevertheless, extreme fluctuations occur almost on the equator, even in oceanic islands. At Malden Island (lat. 4°S.), the annual total rainfall was 3.9 inches in 1908 and 63.4 inches in 1905. At Ocean Island (lat. 1°S.), the rainfall was 19.6 inches in 1909, 159 inches in 1905, and 141 inches in 1911. There were 74 rainy days there in 1910, and 232 in 1911. At Maui, Hawaiian Islands (lat. 20°45'N), 2.46 inches of rain fell in 1912 and 33.14 in 1918. Such variations are common in the Hawaiian Islands. These figures are all the more remarkable when it is noted that none of the insular stations mentioned are within the hurricane zone, and none are near large land-masses.

Extreme droughts and destructive floods are common in tropical regions that suffer from undependable rainfall. India and South China are frequently visited by such disasters, and

tropical Australia even more so, being saved from terrible famines only by the sparseness of its population and the skill exercised in reducing losses to a minimum.

Excessive rainfalls in short periods again are common in tropical countries. In Northern Australia, according to official records, 10 inches or more of rain fell in 24 hours on 400 occasions; 20 inches or more, on 42 occasions, and 30 inches on 4 occasions. The maximum was 35.7 inches in 24 hours on 2nd February, 1893, at Crohamhurst, Queensland. At Suva, in Fiji, 26.5 inches of rain fell in less than 4 hours on 8th August, 1906. Possibly the world's record for amount of rain falling in 24 hours occurred near Manilla on 14th-15th February, 1911, 46 inches. At Cherrapunji, India, 40.8 inches fell in 24 hours on 14th June, 1876; and at Silver Hill, Jamaica, in 48 hours, 57.5 inches. With such sharp annual and daily rainfall extremes, it is reasonable to expect great monthly extremes within the tropics, and this is found to be the case when official records are tabulated. The number of rainy days in the year may also vary very greatly from one year to another, and a month that is very dry one year may be excessively wet another year. One example here will suffice. At Ocean Island, within a nine-year period, 0.1 inch of rain or less fell during each of the months February, March, April and November, but amounts equivalent to 21.3 28.9, 27.6 and 15.5 inches respectively, were also recorded for these months.

Seasonal rainfall is much more variable in the tropics than in temperate regions. Wet and dry seasons regularly alternate, and often no rain at all falls for six months of the year whilst 15 to 60 inches or over fall in the remaining months.

4. *Local climatic variations.*

Climatic differentiation, due to altitude, slope, nearness to water-masses or elevated land-masses, is especially noticable in the tropics. It is stated, for example, that the city of Honolulu possesses a dozen climates. Within its limits, the average annual rainfall varies from 25 to 75 inches, depending on local position relative to the neighbouring mountains. There are corresponding variations in cloudiness and humidity. The range of night-temperature also varies greatly, depending on the incidence of cool valley-breezes.

It is not uncommon in the trade-wind belt in the tropics for the windward side of a mountain chain to receive a great deal more rain than the leeward. Thus on the windward side of Mt. Waialeale in Kauai, Hawaiian Islands, 500 inches of rain fall annually, whereas on the leeward side, only 22 inches fall. On Maui Island, 246 inches of rain fall annually at Eke, elevation 4,600 feet; 15.9 at Punhele, 10 miles south-east, and at Lahaima 10 miles east, only 15.3 inches.

It is thus evident that tropical climates are less uniform than is generally supposed, and it is mainly because civilized races are better able to cope with unfavourable conditions, that they are more successful than less-advanced native peoples in colonizing and utilizing tropical areas for crop production.

BAY OIL AND BAY RUM IN THE WEST INDIES.

WE have recently received a pamphlet on these topics by Messrs. A. E. Collens and F. H. S. Warneford, of the Leeward Islands Laboratory, Antigua, B.W.I. It is published in Dominica. The bay rum industry flourished in St. Thomas as early as 1878, and that island has long been regarded as its headquarters. During 1880 to 1900, bay leaves were exported from Dominica in considerable quantities to St. Thomas and to New York. Bay rum was also manufactured in these years in northern Dominica. Since 1898, the industry in Dominica has declined, to be revived again, however, in recent years. Since 1902, Montserrat has produced considerable quantities of bay oil, and during the past few years, the bay industry has received considerable attention in St. Lucia.

There are at least three varieties of Bay tree, but of these only one, the true *Pimento acris*, is suitable for bay rum manufacture. The tree grows well in the West Indies. It has been systematically cultivated in Montserrat since 1903.

Bay oil.

Bay oil is prepared by steam distillation of the leaves of the bay tree. The oil distils over in two portions, a light oil first, then a heavy oil. Normal bay oil is a mixture of these two. Light oil contains substances of low boiling point, such as myrcene (b.p. 167°C) and phellandrene (b.p. 174°C). Its components belong chiefly to the class known as terpenes. Heavy oil, on the other hand, contains substances of higher boiling point, such as chavicol (b.p. 237°C) and eugenol (b.p. 252°C), and comprises phenolic substances mainly. Citral (b.p. 228°C) probably occurs in both light and heavy bay oil. It is a terpene aldehyde of sweet smell. It occurs characteristically in citrus essential oils, such as lemon oil and lime oil.

Because of its content of phenolic substances, normal bay oil attacks certain metals quite markedly. Tin and copper are the most resistant metals, and bay oil stills should at least be furnished with tin or copper condenser tubes.

Yield of Bay oil.

The average yield of bay oil is between 1.0 and 1.5 per cent. by weight of green leaves taken. It varies with the particular strain of bay tree grown, and on the condition of the leaves as regards moisture-content at the time of reaping.

Bay rum.

Bay rum is usually prepared by mixing bay oil with alcohol, which must contain no initial flavouring matter. Silent spirit, not white rum, should therefore be used in making bay rum. Ten gallons of alcohol of 7 degrees underproof (containing approximately 53 per cent. by volume of alcohol) mixed with 3 ounces of bay oil gives a suitable bay rum. Denaturents should be added. Bay rum should be stored and shipped in clean wooden casks or stoneware jars, because it acts on metals even more energetically than does bay oil.

F.H.

TROPICAL WORLD NOTES.

Mauritius.

The Colonial Office Report for Mauritius for 1924 (No. 1281) a copy of which has just reached us, has the following to say regarding the entirely agricultural industries of the island. The cultivation of sugar-cane is the chief industry of Mauritius and covers about 171,000 acres, or roughly, one-third of the total area of the colony. Excepting British India, Mauritius is the largest sugar producing colony among the British possessions, the production for the last five years averaging about a quarter of a million tons. The system of centralisation now in vogue, will result in a considerable reduction of the present existing number of sugar factories—50 in all—ranging in productive capacity from 1,500 to 15,000 tons. Most of the labourers are East Indians, and as a result of the prohibition of Immigration from India in 1910, Mauritius was one of those colonies which suffered seriously for want of labour. As a result of the visit of Kunwar Maharaj Singh, C.I.E., in 1924, Immigration was resumed subject to certain conditions, for a period of twelve months ending on 31st May, 1924. In the meantime a number of Immigrants, pending negotiations, had been repatriated to India, which made the situation all the more serious. In order to cope with the shortage of labour the planters adopted instrumental cultivation. Ploughs and mechanical tractors had been imported to the value of Rs. 186,235 and the number of estates using these instruments is increasing. The fall in the price of sugar since 1921, which led to a reduction of about 5,000 acres in the total area under cane cultivation, has aroused real interest in various minor cultivations. The area under Aloe Fibre cultivation is estimated at about 20,000 acres, the sale price per ton in 1924 being, roughly Rs. 375. The other subsidiary industries, such as coconuts, tobacco, vanilla and tea, are all receiving the scientific attention of Government.

In connection with the College of Agriculture, definite provision has now been made for students desiring to sit for the examination for registration as Agricultural Chemists, Veterinary Surgeons, and for the examination of the City and Guilds of the London Institute. Funds for maintenance of the College are provided by means of an export tax on sugar of three cents of a rupee per 100 kilos exported, levied under Ordinance 2 of 1922.

East Africa.

The Gold Coast Government's new Commercial Intelligence is shortly to be opened at Abbey House, Victoria St., Westminster, S.W.1., the Director of the Bureau being Lieut.-Col. J. H. Levey, D.S.O., who is at present making an extensive tour of the Gold Coast. Meantime the Colony has a temporary office at Lloyds Bank, Abbey House, in charge of the Assistant Director.

Uganda.

From the 1924 Colonial Office Report for Uganda we learn that the value of ginned cotton exported during 1924, amounted to £3,486,565, which amount represents practically 90 per cent. of the entire export trade. This is a new record and is due to favourable climatic conditions both for the growth and for the picking of the crop. During the previous year the very high prices paid to growers had the effect of stimulating them to increased activity in the preparation of larger acreages for the 1924-25 crop. The total acreage under cotton cultivation for 1923 was returned at 418,600 acres, while in 1924 an appreciable increase of 154,200 acres on the last year's cultivation was observed. During the year, 21,093 tons of cotton seed valued at £106,280 were exported.

It is noteworthy that in spite of a set-back which occurred as a result of an ou break of rinder pest in the eastern province, further progress was made in the use of ploughs by natives, the ploughing schools in Burganda which are now in full swing serving as an excellent training ground.

With regard to coffee which ranks second amongst the domestic products of the Protectorate and is the principal crop on European plantations, the exports amounted to 41,093 cwt., valued at £167,696. In conjunction with other cultivations rubber continues to progress, as over 608,300 lb., were exported during the year as against 398,600 lb. in 1923.

Ashanti.

Cocoa is the principal product of Ashanti and the wealth derived there-from is the foundation of the peace and prosperity of the country. The Colonial Report for 1924-25 (No. 1280) states that the crop throughout was good and the yield about equal to that of the previous year. The quality was slightly better, indicating a steady improvement. Prices were very much better throughout the year. For a load of 60 lb. of cocoa the price opened in Kumasi at 9*s* increased rapidly to 19*s*. and then gradually fell to 15*s*. 6*d*. at the end of the year. The rates charged for transport of cocoa by motor lorries varied from 10*d*. to 1*s*. 6*d* per ton mile as compared with 1*s*. 3*d*. to 1*s*. 11*d*. for the previous year, the lesser rate being charged on main roads where heavy lorries are used. There was much fluctuation in rates but a general reduction took place as the main season crop was harvesting owing to the increasing competition as more lorries were put into commission. Syrian owner drivers with American lorries have so reduced rates that it is doubtful if any transport company can profitably compete with them. Cocoa areas are extending in the Mampong and Obuasi Districts and in the Western Province. The Government is not, however, confining its attention to the cultivation of cocoa only and various experiments are being conducted at the Agricultural Stations with indigenous and introduced crops.

Sierra Leone.

During his West African tour, Mr. Ormsby-Gore, Under-Secretary of State for the Colonies, made a three days' tour of the Sierra Leone Protectorate. The Agricultural Department has been re-organised and enlarged since 1922 and is now engaged upon an economic survey of the land. According to the *Times*, Mr. Ormsby-Gore expressed himself as clearly of the opinion that the problem of palm-produce in Sierra Leone, differed radically from that in Nigeria. Nigeria exports a high percentage of oil compared with kernel, whereas Sierra Leone has a comparatively small oil export and a large kernel output. The oil content of the Nigerian palm is higher than that of the Sierra Leone palm, and whereas the introduction of plantations was neither practicable nor desirable in Nigeria the position in Sierra Leone was different. Experiments are being conducted at Njala to ascertain the most suitable variety of tree. Since the basic food of the people is rice, it is essential that methods of cultivation and yield should be improved. The yield of swamp rice is quadruple that of hill rice and cultivation continuous compared with the shifting cultivation of hill rice. The road system is less developed than in Nigeria or the Gold Coast but the topographical survey now progressing should facilitate such development. Head transport is expensive and diverts much labour from more productive operations. Mr. Ormsby-Gore was impressed by the Protectorate Boys' School at Bo for the sons of chiefs. The medical and sanitary work at Freetown is distinctly ahead of that of most colonies particularly in infant welfare.

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Gold Coast.

The revenue for the year was £3,971,187, but expenditure exceeded revenue by £661,446. Accounting for this deficit, however, the Colonial Report for 1925 (No. 1287), explains that £804,300 of this expenditure was in respect of loan works which will eventually be repaid to revenue, together with the sum of £950,814 similarly expended in 1924. There is also a sum of £540,417 standing to the credit of the special reserve fund. The Colony's trade imports for the year under review totalled £8,315,234 but suffered a decrease of £133,628 compared with the value of imported articles in 1923-24. This is due to depreciation in prices of imported articles and not to a decrease in the quantities imported. On the other hand exports amounted to £9,914,937, which is greater that the previous year's export transaction to the extent of £955,724. Cocoa is the principal exportable commodity and reached the record figure of 223,329 tons which is almost equal to half the world's production of the cocoa bean. Large diamondiferous areas are being discovered and over 102 carats to the value of £365 were exported during the year.

Philippine Islands.

During 1925 business conditions were in many respects the most satisfactory on record, recovery from the depression that followed the post-war boom being more pronounced than in any year since the collapse of 1921. The sugar output was the highest in the history of the Islands, but this advantage to some extent was offset by lower prices. The output of several manufacturing industries substantially increased, especially that of desiccated coconut, a comparatively recent activity in the Islands.

The American Trade Commissioner at Manila reports that general conditions in the wholesale and retail trades were never better, with the exception of the temporary inflation during the post war boon. In some lines the volume of sales exceeded the corresponding business of 1920. Although there were several business failures, chiefly among the Chinese, and a few firms were known to be financially embarrassed, these were difficulties, in most instances, of long standing. Both wholesale and retail merchants continued to report increasing competition and the necessity of working on smaller margins of profit, but the total results for the year were in general highly satisfactory. The financial situation continued to improve, and the condition of the banks at the end of 1925 was most satisfactory.

An outstanding feature of the commercial life of the Philippines during the past year has been the interest developed in the possibilities for production of Para rubber in the Islands. Several companies were formed during the last half of 1925 and others are in formation, which propose to develop rubber plantations in the southern islands. The Government is offering to assist prospective planters in various ways.

Although general business conditions since the close of 1925 have been considered better than in the first part of any year since 1920, several factors of recent development suggest the advisability of a conservative point of view in regard to the future outlook. Copra production for the first quarter of 1926 was substantially under that of the previous year, although prices have been considerably above the 1925 average. A sharp decline has occurred in demand and prices offered for abaca. Indications are that the new sugar crop may be below that of last year, and lack of rain threatens to cause an important shortage in the current tobacco crop. With few exceptions, however, basic conditions appear to be sound, and general confidence is evident.—*Chamber of Commerce Journal.*

A gratuitous specimen copy of *Tropical Agriculture* will be sent, post free, to any members of an agricultural society or to any other individual interested in tropical development on application to the Editor, *Tropical Agriculture*, The Imperial College of Tropical Agriculture, St. Augustine, Trinidad, B.W.I.

INDIAN AGRICULTURE.

The Royal Commission's Task.

[*The following, taken from the Pioneer Mail, 11th June, 1926, is the report of Lord Irwin's address, delivered at Simla on 7th June, 1926.*]

HIS EXCELLENCY THE VICEROY, addressing a conference of Ministers and Directors of Agriculture from the Provincial Governments said :

" Before I was appointed to my present office, I was responsible as Minister of Agriculture in England for the activities of the Government in this sphere. Before that again, I had for many years past farmed a good deal of my own land in England. I accordingly welcomed the opportunity of making the acquaintance of the Ministers of Local Governments who are responsible for the agricultural policy in the Provinces, and of the Directors who are concerned with the execution of the policy and the technical and scientific operations of the Provincial Agricultural Departments. It is, therefore, a pleasure to me to be able to meet you to-day and this contact I shall hope to renew when I visit the different provinces. I shall then, I trust, have opportunities of acquiring at first hand, information of your achievements, and of seeing something of the projects you have in contemplation. You can count on my constant interest in all you are doing, and on my profound conviction of the importance of your work both to the Local Governments and in relation to the general prosperity of India.

Circumstances invest our meeting with a special importance. This conference has been called to discuss certain preliminary steps connected with the forthcoming enquiry by the Royal Commission. Its aim is to concert measures by which the work of the Commission may be facilitated, and to prepare a field in which the Commission, on arrival in India may, without obstacles or complications, forthwith put its hand to the plough and proceed with its task.

The reasons for the appointment of the Royal Commission have been fully explained in published official papers, and in public speeches made by my predecessor, Lord Reading, and, as the proposals for the enquiry received the general approval of the Local Governments, whose advisers in these matters you are, it is unnecessary for me to dwell further upon them now, save to express my own satisfaction that an enquiry with such wide possibilities of benefit to India is to be held during my period of office.

There is good reason to be satisfied with what has been achieved in India in recent years in connection with the improvement of agriculture, both in the spheres of central research under the Government of India and of the Provincial Governments. Nevertheless, I am convinced that the right moment has come for the examination of agricultural policy in its widest bearings by an independent body of real authority. A stage in agricultural development has been reached where the reactions of the problem have become so important that they deserve investigation, not only from the inside as we see them, but from the outside, and from a different line of approach. Excluding some sporadic and intermittent work at an earlier period, almost a quarter of a century has now passed since Government first began to undertake systematic operations for the improvement of agriculture in India. These 25 years have seen the establishment and growth of scientific agriculture. During the same period there has been a remarkable expansion in irrigation facilities. A change has in this manner been brought about in the area and conditions in which the results of agricultural research can be demonstrated and applied. We are on the threshold of further developments in this direction. From this point of view the time is favourable to take stock of the position by examining and comparing the scientific and technical work carried out by Central and Provincial agencies, by testing its utility in the light of scientific work elsewhere, and above all by considering whether development on the present lines is by itself sufficient to secure progressive improvement in rural conditions, or whether it will require to be supplemented by other measures, different in character or more comprehensive in scope.

There are other reasons why the improvement of Indian agriculture has become a matter of more than purely domestic interest. India now has a definite place in the markets of the world. Her position as a source of supply of cotton, jute, wheat, oilseeds and other raw products is likely in future to be increasingly important to consumers in other parts of the world. The expansion of the quantity and the improvement of the quality of Indian agricultural produce is a matter of serious concern in the general economic structure of the world's supply of food and clothing. The development of India's agricultural potentialities has now become essential to the maintenance of her commercial position. It is vital to her financial position and to the economic welfare of her people. India has to bear in mind the possibility of organised competition from other quarters in certain lines of supply where she now meets a part of the world demand, and receives a substantial income in return. Fluctuations in the bulk of her supplies or inferiority in quality as compared with supplies from elsewhere, might at any moment cause her to lose a market with those disastrous repercussions on her commercial, financial and economic position which a contraction in exports must involve.

The most important problem of all is the welfare of the Indian agriculturist. More than 71 per cent. of the population of India are entirely dependent for their livelihood on agriculture. The population of India generally is rural rather than urban. The large town and the industrial centre is the exception. The common feature is the hamlet and the village, and it is in rural life that both in the past and present India has found her most distinct medium

of self-expression. The Indian agriculturist is accordingly the foundation upon which the whole economic prosperity of India rests, and upon which the structure of her social and political future must in the main be built. No system of administration could be justified which did not aim at making an improvement in his standard of life and his equipment to take a proper share in her future its first and chief concern.

I recognise that the Provincial Governments in their administration have never lost sight of this ideal, but with the constitutional changes of recent years, it has become increasingly evident that the rural elector is bound to play a great part in the destinies of India, and the question of fitting him to understand and exercise his responsibilities has now emerged as one of the most pressing problems of present-day conditions in India. Any light which can be thrown from a new angle of view on the question of improving his position will be of the greatest service to the future of the country, and no avenue should be left unexplored which promises to lead to some new line of development or to some hitherto unperceived potentiality of progress.

One of the most insistent of the questions for exploration is whether the economic condition of the peasantry has improved *pari passu* with the other great changes which have taken place in India during the past years. With her entry, for example, into foreign markets, with the improvement in communications and with the rapid growth of commerce, and if the answer is in the negative, what are the causes that operate to prevent the agriculturist getting his proper share in the influx of wealth? The standard of life of the Indian peasant is the deciding factor, not only of his own rate of progress, but also of his contribution to the volume of the world's industrial demand, on which in a world daily growing in this sense more compact, the daily bread of so large a number of his fellow human beings depends. If it be the case to-day that Indian agriculture can, for the majority of those concerned, only produce rewards at too low a subsistence level to permit of much progress in general living standards, what courses are open to us? We can acquiesce with good or ill grace, according to temperament, in things as they are. We can seek a remedy by the reduction of number of those striving to live off the products of Indian soil. Each of these surely is a counsel of despair. Finally, we can change the position to India's advantages by calling upon science to unlock her secrets, and take the most practical steps to overcome the obstacles which impede the lessons of scientific research from permeating the working practice of the cultivators.

The difficulties by which the general improvement of agriculture in India is hedged about are so well known to you that it is unnecessary for me to dwell upon them in detail. The recurrence of cycles of deficiency in rainfall, scarcity of capital and high rates of interests, excessive fragmentation of holdings, the ravages of pests and diseases, the absence of markets for what are profitable by-products of land in other countries and the consequent concentration of tillage and crops and the great diversity of crops grown combine to create a collection of problems for scientific investigation which are not only peculiar to India, but unique in their range and complexity. It is to assist in finding the solution of those difficult questions, so vital to the well-being of the Indian agriculturist and the future of the country that the labours of the Royal Commission will be directed.

Though nature and human nature are both very conservative forces, and, therefore, in matters where they divide the ground between them it were imprudent to anticipate immediate and spectacular results, I am yet confident that the recommendations of the Commission will prove of the greatest value to India, and may indeed lead to a new era in agricultural developments, and give effective impetus to the promotion of rural prosperity. You—gentlemen, are specially qualified to appreciate how heavy the task is which lies before them, and I am confident that your discussions regarding the preliminary steps to be adopted to facilitate their work will materially contribute towards the successful issue of this important enquiry."

WE understand that Mr. Ormsby-Gore Under-Secretary of State for the Colonies, is now engaged upon his report on his recent tour to West Africa. Generally the report will follow the lines of the East African Commission of 1925 and will deal more particularly with further railway development in Nigeria, and additional road construction in Nigeria and Sierra Leone. A special section will deal with the oil-palm industry. Special emphasis will also be laid upon medical and veterinary problems in Nigeria and the Gold Coast. Mr. Ormsby-Gore expressed himself as being greatly impressed with the enormous potentialities of Nigeria. He stated that "the most rapid advance now in Nigeria is in cotton and within the next few years Nigeria is destined not only to catch up, but to pass Uganda as the premier British cotton-growing country in Africa. The only thing that hinders very rapid advance in cotton-growing is the scarcity of ginneries and the lack of transport facilities. Both Nigeria and the Gold Coast are prosperous financially, and all British West African Colonies are in a position to raise loans on their own credit. Unlike East Africa, therefore, there is no question of any proposal corresponding to the ten million loan for East Africa." He laid stress upon the importance of an extended use of motor transport owing to the prevalence of the tsetse fly which makes animal transport impossible. In the Gold Coast with its extensive system of motor roads there were only 132 British motor lorries in use compared with 1,741 American. "In the Gold Coast," he continued, "the construction of the great harbour of Takoradi has presented very great difficulties that are now in a fair way to solution. The main breakwater had reached a length of 1,750 yards when I was there."

FRUIT REPORT OF THE IMPERIAL ECONOMIC COMMITTEE.

I—Production and Grading.

THE fruit report recently issued by the Imperial Economic Committee is so replete with information on the various aspects of the fruit trade that it is difficult, if not impossible, to give any adequate summary. The difficulty arises from the complexity of the organisation; the selection of variety, the cultivation of the crop and production of the fruit, the supply of the wholesale market and the subsequent retailing, are a series of stages each of which, though a certain and considerable degree of interdependence runs through all, has its own peculiar problems not the least of which is finance. I propose here merely to deal with the production end of the series.

A perusal of the report brings into a prominence which is outstanding, one feature of successful production; all countries which have succeeded in establishing a fruit trade have done so by a process of grading. Grading is the process by which fruit, or, for the matter of that, any produce, is classed so that the purchaser is able to buy by mark and without inspection. Simple in its end, it is complex in the organisation required to attain it. In fruit the unit of production is the tree. If bulk production of graded fruit is to be arrived at, the first consideration must be the organisation of a sufficient area planted to a single variety. In many cases, however, it is not sufficient to stop at the variety. Where the unit of consumption is, as in Citrus, the single fruit, a further grading into size has to be made. To any one who visits, for the first time, estates producing fruit of this class, the care which is given to grading the fruit by size and to subsequent packing with each fruit wrapped and occupying a determined position in the crate, cannot but be a cause of surprise.

The first stage, then, from the production point of view, is the growth of a sufficient area of a single variety; a simple act, for it is as easy to plant one variety as several, but by no means simple to carry into effect on an extensive scale. Before it can be done an answer is required to the question, what variety is to be grown? This is a matter requiring experiment. In most countries where any question of establishing a fruit trade arises, however, a sufficiency of practical experience has probably indicated, if not the most suitable variety, a variety sufficiently satisfying the conditions for production to go ahead. Experiment, thus, is limited to checking the soundness of that decision, to determining the cultural conditions leading to the largest yield of quality fruit and to the production and testing of other varieties suitable for replacing that in general cultivation. The latter is an essential point, sometimes overlooked. In the poorest agricultural tracts with which I am acquainted, those of Bandelkhand in India, the common practice is to sow wheat, barley, mustard, linseed, gram and perhaps other peas in one field. The basis of this practice in a country of precarious conditions is insurance by a population unable to carry the risks of a single crop. If some of these fail the others may give some return and the cultivator is not left entirely destitute. The risks that attach to a single crop are intensified when a single variety only is widely cultivated. The entire plant population is likely to be susceptible to the same disease or the same adverse conditions and is, therefore, liable to suffer simultaneously. Clearer instances of this effect cannot be given than those of panama disease in the banana and wither tip in the lime. No industry, therefore, is safe which does not adopt so essential a precautionary measure as developing and holding a reserve of suitable varieties.

Having selected the variety it is now necessary to arrange for its extended growth. Here methods will differ with the economic situation. In South Africa, for example, Citrus cultivation is undertaken by large land companies which control a greater or less extent of land. These areas are subdivided into smaller units to which settlers are attracted. Here matters are simple; the cultivation is a new industry and conditions and stipulations, which ensure the essential conditions, are laid down in the terms of agreement by which the settler enters into possession.

The process is not so easy when the attempt is made to introduce fruit production for the trade into a settled country, especially when it is a country of small holdings. Here each owner of land and even each cultivator will be a law unto himself. He will try out different varieties and, as often as not, will end up with an orchard containing a large number of varieties good, bad and indifferent. He is unable to supply graded fruit for no two successive pickings will be uniform. Under such conditions the first step towards the establishment of a trade must be the elimination from general cultivation of all but that variety which has been selected for the purpose and concentration of varietal work under one control. This implies organisation and an organisation not easy to establish for, to some producers, who have not paid attention to the selected variety, it will mean the practical exclusion of their crop. There are two methods in which such a simplification of the crop can be effected; the first is a voluntary one. What can be achieved by voluntary co-operation we have the experience of Denmark to show us, but for voluntary co-operation certain fundamental conditions must exist. For an export trade demanding specialised shipping facilities, which is the concern of tropical countries, a prime consideration is bulk. Each area, therefore, has to ask itself, can a sufficiency of the producers be brought into voluntary co-operation to supply that bulk? The alternative is compulsion by legislative enactment. Clearly an organisation, built up on a voluntary basis, is the more desirable, and its replacement by compulsion must depend firstly on the lack of effective voluntary effort and the importance of the trade to the community.

The second stage arises when the initial difficulties connected with the propagation of a uniform variety have been overcome. It is the grading of the individual fruit for the market. Again methods depend on the economic conditions of production. In large scale production the 'estate' may be sufficiently large to market its own fruit under a trade mark which will be recognised by the trade. Smaller units, however, are not in a position to market in this way and, again, one of two methods may be adopted. In countries where the unit holding is relatively small a trade organisation may itself establish agencies to buy and grade the fruit, or the grading and packing and marketing may be done co-operatively. The selection of method is largely dependent on finance, a subject which cannot be discussed in this article. General experience, as indicated by the report, seems to show that for those fruits, such as Citrus, Bananas and Apples, the trade in which has become highly organised, a co-operative organisation has small chance of surviving, unless it has at disposal a bulk of fruit sufficient to carry the overhead charges of a selling agency in London, or at other markets on which the fruit is to be disposed. The function of co-operation would here appear to be limited to providing an organisation to deal with the buying agency.

The function of Government has been referred to above and requires further consideration. Here again the extent to which Government assistance is desirable or justifiable will depend on economic conditions. Where no strong planters' agency exists it naturally falls to the Agricultural Departments to perform the experimental work; while other functions are best carried out co-operatively it may, and in many cases has, been found desirable to control the grading by legislative enactment. Both in Australia and New Zealand standards are fixed by Government to which the co-operative agencies conform while in Canada the fruit is subject to inspection by Government inspectors who are in a position to institute prosecutions if the legal standard is not maintained. Similarly in South Africa the export supplies of Citrus are subject to Government inspection. These are extreme cases and the exact amount of Government control will be determined by the extent to which the market interests concern themselves with the producing end of the trade and this again depends on the methods adopted for financing production. The question of finance will be dealt with in a subsequent article.

H. M. LEAKE.

Subscriptions to Lord Milner's Appeal for £100,000 as an endowment fund for the Imperial College of Tropical Agriculture should be addressed to the Secretary, Imperial College of Tropical Agriculture or to the bankers of the Fund, the Colonial Bank, 29, Gracechurch Street, E.C.

SUGAR-CANE IN BAHIA.

ALEXANDRE GRANGIER, *in Bol. Min. Agr. Ind. e Com. Brazil* (*Feb.-Mar.*, 1926), pp. 143-163; 283-318.

AN official monograph on the cane sugar industry in Bahia. The climate is discussed, but it is stated that in the whole region there is not a single meteorological station and that no reliable data as to rainfall, &c., are available. The soil is mostly a tertiary clay and ordinarily yields a good growth of cane; plant cane is cut in 14 or 15 months, and on the average there are 4 ratoon crops. Cultural methods are primitive. About 20 varieties of cane are cultivated; the chief of these is the "Canna roxa" (red cane) in two varieties—Luisier and Bois-Rouge; these occupy four-fifths of the total area. On the plantations of the usina "Sao Bento" which is said to give the growing cane better care than other usinas, the sugar content of the cane averages around 13.5 per cent. with purities around 85. The months of major rendement are Sept.-Nov.; from December on to March the quality continually decreases. The cane is generally free from disease, but the black beetle, *Podalgus humilis*, has assumed considerable importance as a pest.

The Bahian sugar factories, with 3 exceptions, are well equipped; the care bestowed on the mills is out of proportion to the attention given to cultural operations; the average rendement is 8.5 to 9.0 per cent.; the extraction is 65 to a maximum of 90 per cent.; grinding batteries have from one to four mills; a few mills have chemical control, and this is becoming more general; first, second, and third strike sugars are produced; a few mills distil their molasses, the others sell to a central co-operative alcohol factory, the molasses being transported by mules and by tank cars.

The average cost of producing a ton of cane (mean of 6 enterprises) is 14 $607; average yield of cane, 37.938 metric tons per hectare. The over-all cost of a bag of sugar in the factory is 35 $724; the value of the products being 49,$000 at current prices. The average net profit per bag of 132 lb. is 13 $276. The 20-year production of the 21 factories of the state (1905-1924-25) is 8,918,272 bags. The total area under cane is 31,500 hectares (77,805 acres).

The report includes extensive details regarding the mechanical and transport equipment of the factories; voluminous statistics are also given.

Directions along which the sugar industry of the State is susceptible to improvement are said to be the introduction of better cane varieties and large scale production of sound seed cane, use of chemical fertilizers and reforestation to secure an adequate supply of fuel.—*Facts About Sugar*, July, 1926.

EMPIRE COTTON.

(*Concluded.*)

In visiting the Sudan Mr. Himbury entered that country from Uganda, leaving from Jinja, crossing lakes Kioga and Albert to Nimule at the extreme south of the Sudan. In the southern Sudan cotton growing is a new industry for the natives, in fact until Government officials interested themselves in the matter the people produced nothing for export; now, however, there is every indication that cotton growing has been definitely taken up by the natives. The cotton there is all grown unde rainfall conditions where only the American type of cotton can be grown. One great drawback is the distance of the ginneries from the field, some of the seed cotton being transported one thousand miles by boat, a journey which takes from 8 to 10 days. Mr. Himbury was also of opinion that rain grown cotton should be continued to be produced in the southern provinces under Government control with assistance when required from the British Cotton Growing Association and the Empire Cotton Growing Corporation, the two bodies in the Empire which are specially organised for this kind of work.

There would seem to be no opportunity at present for commercial enterprise in Cotton growing as the country is in a very primitive stage of development, and, since the crop is one that the natives cannot eat or use to any extent for his own needs, he must be protected and enabled to get a full reward for his labour.

The opportunity was taken to inspect the great dam at Makwar which forms a reservoir fifty miles long with a capacity of one hundred and forty thousand million gallons with a total length of irrigation canals of nine thousand two hundred and eighty-six miles which will make it possible to grow cotton and other valuable crops and thus increase the prosperity of many thousand of the population of the northern Sudan. Four ginneries were already established in the Gezira each building containing two units of forty roller gins complete with press. Electric light was installed and the plants were protected from fire by sprinklers. The output of seven hundred bales per day of ten hours from the three hundred and twenty gins was considered quite good and it was expected that the crop would be finished and away by June.

The cotton in the field looked exceedingly healthy with very little evidence of thrips although in some places the crop had suffered slightly from black-arm. Three and a half cantars had already been picked and an average yield of four and a quarter cantars was expected.

Mr. Himbury pays a tribute to the Sudan Plantation Syndicate for the speedy and thorough manner in which they got this huge area tenanted, the land prepared for cultivation and the ginning factories erected. Mr. Himbury also was very enthusiastic about the energy and ability of the Agricultural and other Government officials in the Sudan where in spite of a very hot and trying climate the whole place seemed very alive and full of energy and had a prosperous look about it. It is predicted that before many years have passed very large quantities of both Sakel and American cotton will be produced and that it will take its place as one of the most important Empire cotton producing districts.

Mr. Himbury's visit to India was in accordance with the agreement made between the Government of India and the Association, whereby a member of the Executive should visit the Punjab each year in order to keep in close touch with the cotton development work in that Presidency.

Since the last previous visit many improvements were made on the cotton estate at Khanewal. The temporary roads have been transformed to permanent roads with good surface. The system of planting clumps of trees in the corners of the chucks to form shelters for cattle has been successful and the tenants make good use of these small copses. With the new growth established older trees may be cut down and up-rooted and land which was formerly waste brought under cultivation. A school for the education of the children has been opened in one of the main villages, and a dispensary with qualified medical attendance is available. A new ginnery was established early in 1925 consisting of a substantial building of brick containing a complete pneumatic saw-ginning plant by Dobson Barlow in the other roller gins by Platt Bros. A large hydraulic plant has been placed in a separate building. Large warehouses and numerous brick islands have been built for the storage of cotton while awaiting ginning. The returns obtained on the yields of cotton on the cotton farm were usually better than those of other growers in the Presidency. This may be due to specially good land or better methods of cultivation, perhaps to a combination of the two. There was a good demand for seed from the cotton farm and the methods employed there were being copied for a considerable distance around. Furthermore the cotton was much in demand and was worth £25 to £50 more on the Bombay and the Liverpool markets.

India is extremely fortunate in having excellent agricultural colleges established in each Presidency, for the carrying out of experiments and the training of experts. Mr. Himbury had visited several of these and was impressed with the immense interest taken by the staff, European and Indian, in the experimental work of the college. The buildings while not being pretentious or elaborate present some special features of architectural design. The laboratories, classrooms, and theatres were lofty, airy and well lighted, and the institutions possess excellent libraries.

Mr. Himbury found all the colleges that he visited were under-staffed and he recommended that all vacancies should be filled as soon as possible, and filled with the best experts that can be found whether Indian or European. In the agricultural departments it was found that while a great deal of consultation had taken place there was still a scarcity of men. In referring

to the advantages gained by India from the maintenance of adequate agricultural departments, reference was made to the extraordinary improvement which had taken place in sugar, wheat, rice and cotton amongst other crops and also to the great advance made in the improvement of cattle, dairying, &c., the credit for which is entirely due to the efforts of European experts, and it was felt that the agricultural services should be recruited to full strength if India is to continue to obtain the value it should from these departments.

The Indian Central Cotton Committee which works on similar lines to the Empire Cotton Growing Corporation was referred to as doing very excellent work. They have an excellent Entomologist, a cotton research station in Bombay, and a recently obtained Cotton Botanist from Egypt, who is attached to the college at Lyallpur; and some further scientific staff is being supplied to Madras for work at Coimbatore. The Cotton Committee also award Scholarships, and after talking with many of the Scholarship students, Mr. Himbury congratulated the Committee upon their selection.

Reference is made to the extension of irrigation works as the most important development in India in connection with agriculture at the present time. Something like 13 million acres are already irrigated in the Punjab and native states and it is possible to increase this to 20 millions. A large portion of this land is eminently suitable for cotton and a fair proportion of it will grow the American type.

The erection of the dam for the Sukkur-Barrage scheme should shortly commence, and if the start is not delayed the work may be complete in 1929 or 1930 when several million acres will be irrigated of which at least one million acres should be suitable for growing a good type of American cotton.

The necessity for the development of proper seed farms in each locality, where new areas are being opened up for cotton planting, is emphasized by Mr. Himbury for the purpose of safe-guarding the interests of the industry as well as of the individual.

In conclusion the opinion is expressed that India has by no means reached its limit as a producer of cotton either in quantity or quality.

H.A.B.

GROWTH IN THE OIL-PALM.

IN the *Annals of Applied Biology* (Vol. XII No. 4, November, 1925) Mason and Lewin describe the results of an investigation into the growth processes of the Oil-Palm (*Elaeis Guineensis*). The observations were made at Ibadan, the headquarters of the Nigerian Department of Agriculture.

It was found that young trees have two flowering cycles in the course of the year, one in the autumn and the other in the spring. The modes of the flowering cycles correspond closely to the two periods of equal day and night. The correspondence is remarkable in view of the latitude of Ibadan, viz.: 7° 22′ 30″. It is suggested that two distinct groups of environmental factors control the seasonal flowering cycles. The first group determines the laying down of the inflorescence primordia and is doubtless identical with that affecting leaf production. The annual distribution of rainfall is considered to be the most important factor in this group. The second group of factors is active in promoting the actual flowering of the inflorescences. It is suggested that the relative length of day and night is a factor of paramount importance here.

The sex-ratios of the individual trees were found to vary greatly. Some trees were completely male throughout 1924, but none were completely female. A few trees produce a large proportion of bisexual spadices. It was noticed that there was a slight tendency on the part of individuals that were especially active in the production of leaves to have a relatively high proportion of female spadices. It seems probable that though genetic factors are the chief importance in determining the differences observed in the sex-ratios, yet the influence of the individual's environment is by no means negligible. It would appear that the relative sex-ratios of the trees do not fluctuate very markedly from year to year, for the correlation coefficient between the sex-ratios of the trees in 1924 and number of bunches produced in the preceding two years amounts to $-0.40 \pm .065$. It is therefore concluded that the sex-ratio is an important factor in determining the yield of bunches of fruits; relatively female trees tend to produce a large number.

It was found that the *sex-ratio of the population shows* a somewhat regular seasonal periodicity. Almost invariably there is an excess of male inflorescences, but this excess becomes particularly accentuated in December. Our data do not permit us to judge to what extent the December excess of males is due to a relatively greater mortality of young female spadices at this time, and to what extent it is due to a true periodicity in the differentiation of sex. It was observed that there was a larger proportion of female spadices in the autumn cycle of 1923 than in that of 1924. Again we are unable to decide to what extent this was due to differences in climate in the two years and to what extent to the age of the trees.

It was noticed that as trees age, there is a tendency for the spring flowering cycle to be eliminated. The suppression of the spring cycle seems to be correlated with an increase in the weight of the individual bunches. This correlation only obtains until the trees are 30-40 feet in height, after which senescence is probably a factor in the economy of the palm. It is suggested that the increasing weight of the individual bunches leads to the exhaustion of food reserves. The strain of maturing the fruits that develop from the autumn flowering cycle must be considerable, for the growth of these fruits takes place in the dry season. It is considered that this exhaustion of the plant's reserves may be responsible for a shortage of female spadices during the spring period of equal day and night.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Synthetic Ammonia in Britain.

Until recently, the only synthetic ammonia plant in Great Britain was the Brunner-Mond plant at Billingham-on-Tees. This produces 50 tons of ammonia per day by a modified Haber process, and is soon to be enlarged to 200 tons capacity, representing some 760 tons of ammonium sulphate. The United Alkali Company has now decided to erect a Casale plant for manufacturing synthetic ammonia. Whereas the Haber process effects synthesis of ammonia from nitrogen and hydrogen by direct combination at a relatively low pressure and under the influence of an iron-alloy catalyst, the Casale process works at a much higher pressure (500 atmospheres compared with 150). The Casale process can be worked conveniently in small units. This favours the erection of numerous small plants in different parts of the country, rather than one or two large plants at localities that may be easily vulnerable in war time.

Competition between Synthetic and By-product Ammonia for fertilizer manufacture.

There is no doubt that synthetic ammonia is fast becoming a serious commercial rival of by-product ammonia of gas works. An important factor in the manufacture of ammonium sulphate from ammonia, is the physical state of the product. Many forms of ammonium sulphate cake badly when packed. Recently a heavy loss was sustained by the British export trade in ammonium sulphate to Japan because of this drawback. The Brunner-Mond plant referred to in the last paragraph, produces the sulphate in pea-crystal form, which is very satisfactory. One London Gas Company manufactures loose needle-crystals of ammonium sulphate, and recently, a new type, described as rice-crystal, has been put on the market. British chemical technologists appear to be alive to the importance of controlling crystallization in ammonium sulphate manufacture, and success will doubtless go to those firms that can produce the most cheaply whatever form of ammonium sulphate fertilizer the consumer desires.—F. E. Hamer, in *Indus. Engin. Chem.*, News Edition, 20th May, 1926.

Sweetness of Sugars.

Messrs. A. Biester, M. W. Wood and C. S. Walin have estimated the relative sweetness of various sugars (*Amer. J. Physiol.*, 1925, p. 387). Their results are expressed by the following figures. Sucrose, 100; fructose, 173.3; glucose, 74.3; xylose, 40.0; maltose, 32.5; rhamnose, 32.5; galactose, 32.1; raffinose, 22.6; lactose, 36.0. The relative sweetness of invert sugar (a mixture of fructose and glucose), was 127.4, when prepared from sucrose by the use of the enzyme invertase, but 130.0 when prepared synthetically.

Acetone from Vegetable Materials by Fermentation.

The demand for acetone in various industries is rapidly increasing. As a solvent and extracting agent, acetone is largely used in the preparation of explosives, celluloid, cinema-films and viscose or artificial silk. It is also being increasingly employed, mixed with alcohol or benzene, as liquid fuel.

In recent years, acetone has been prepared on a large laboratory scale from potatoes, maize, rice, molasses and sugar-beet residues. The process employed is one involving bacterial fermentation. During the war, the British Admiralty adopted a fermentation process for manufacturing acetone from rice starch for use in making cordite. The process is expensive, however, and is unsuitable for peace-time production. Nevertheless, it appears possible that the costs of manufacture of acetone from vegetable materials may largely be reduced. Thus Dr. Bakonji, chief chemist of a large distillery in Budapest, Hungary, claims to have evolved a cheap large-scale process for manufacturing acetone from different starches and molasses. Maize and rice are the most suitable raw materials, because they can readily be obtained pure and free from undesirable bacterial infection. Pure cultures of specific bacteria, such as *B. macerans* and *B. aceto-ethylicus*, are employed to effect the change from starch to acetone.

The starch is sterilized, then very finely ground. It is mixed with 15 to 20 volumes of water in a fermenting vat, and 10 per cent. of chalk is added to neutralize acids (acetic and formic acids mainly) that are generated during fermentation. The mixture is further sterilized by blowing in high-pressure steam for two hours. Afterwards, it is cooled to 41°C., and heavily inoculated with the bacterial culture. Fermentation is allowed to proceed for five to seven days. During the process, large volumes of gas, chiefly carbon dioxide (58 per cent.) and hydrogen (42 per cent.) are liberated. The gas is collected and cooled in order to separate acetone and alcohol (butyl alcohol) that are carried over as vapours. Hydrogen forms a valuable by-product. Finally, the fermented mass is distilled to isolate further quantities of acetone and alcohol, which are separated by fractionation. The residue is used as feeding-stuff.

The yields claimed for this Hungarian process are high, namely, 12 to 14 parts by weight of acetone, and 24 to 26 parts of alcohol from 100 parts by weight of starch. The costs estimated are about the same as those of an ordinary distillery, and compare favourably with the costs of manufacture of acetone from wood by destructive distillation.—W. G. Cass in *The Industrial Chemist*, May, 1926.

There appears to be a wide field open to the industrial microbiologist, and it is to be hoped that tropical agriculturists will avail themselves of his services for the better utilization of many of their products and factory waste materials.

COLLEGE NEWS.

Professor E. A. Seagar, at the invitation of the International Health Board, sailed for New York to attend a series of Health Conferences.

Mr. C. F. van Rooyen, post-graduate student, sailed for Costa Rica on the 31st July, where he will spend some time before returning to South Africa.

Revs. C. D. Lalla and A. E. Dyett, J.P. of British Guiana visited the College on the morning of 21st July, and were shown around the buildings by Professor Ballou.

Professor H. A. Ballou left for the Northern Islands on the 31st July, in connection with the work of the Imperial Department of Agriculture for the West Indies.

Messrs. H. E. Bulwer and A. Rifat, post-graduate students, sailed for England on the 10th August by the s.s. *Bayano, en route* for South Africa and Egypt respectively.

A welcome addition to the funds of the College has recently been received in the provision of annual contributions from Nigeria, £1,200; the Gold Coast, £500; Sierra Leone, £250; and British Honduras, £50. Not only are the sums of themselves welcome, but they indicate a pleasing widening of the field from which the College draws its contributions.

Dr. C. L. Withycombe has resigned his position as Lecturer in Zoology and Entomology at the College. Dr. Withycombe has been appointed Lecturer in Entomology at Cambridge University. During the past three years Dr. Withycombe has interested himself in several local Entomological problems and has published papers on Cotton Stainers, the Trinidad bollworm and the Froghopper blight of sugar-cane in Trinidad and in addition has been a frequent contributor to the columns of *Tropical Agriculture*.

BIRTHDAY HONOURS.

THE list of Birthday Honours includes the names of the following Governors of the Imperial College of Tropical Agriculture:

C.M.G.

Hill, Arthur William, Esq., SC.D., F.R.S., Director of the Royal Botanic Gardens, Kew.

KNIGHT.

Himbury, William Henry, Esq., General Manager, British Cotton Growing Association.

C.B.E.

Walcott, Henry Barclay, Esq., C.M.G., Treasurer, Colony of Trinidad and Tobago.

The subscription to *Tropical Agriculture* is six shillings per annum, post free, to all countries within the British Empire or seven shillings, post free, to all other countries. Subscriptions can commence at any time during the year.

BOOK REVIEW.

FRUIT AND THE FRUIT TRADE.—By Ford Fairford, Lond.: Sir Isaac Pitman & Sons, 1926, pp. xii+154. Price 6*s*. net.

In this elementary little book the author deals with those familiar fruits such as apples, pears, bananas, &c., which are common commodities of every day use. The text matter is adequately illustrated by a series of excellent photographic reproductions. The reading matter though necessarily superficial is nevertheless interesting and, in general, accurate. One wonders why, on p. 83 the author includes the statement that, "Even vinegar, sugar and coffee are also produced in the West Indies and Central America, but they seldom, if ever, reach Great Britain," since it has no apparent reference to the context. In spite of blemishes such as this, the book should provide agreeable reading matter to those who desire to obtain some elementary information upon the source of our commercial fruit supplies.

C. Y. SHEPHARD.

RICE.

The Record (Bangkok, Siam; English Edition No. 18, October, 1925, p. 116) contains a report on the padi crop of Siam for the year B.E. 2467 (1924-25). Of the total area planted amounting to approximately seven million acres, four million acres were within the seven circles which provide the bulk of the exported rice. In these circles the crop for the year amounted to 2,845,000 tons of padi, and was about 654,000 tons more than in 1923-24 and about 470,000 tons more than in 1922-23. The average yield of the fields harvested works out at 0.76 ton per acre, an increase of 0.09 ton per acre over the yield in 1923-24. The cultivation of padi in the seven exporting circles is definitely on the increase.—*Bulletin of the Imperial Institute*, June, 1926.

THE Washington Department of Agriculture is putting into effect its recent decision to change the form of its cotton production reports so as to give three alternative groups of crop estimates, each based on a different method of computation. Under the proposed new system, when the Department makes its first report on the prospective size of this year's crop, the following figures will be included: the indicated production based on the condition of the acreage under cultivation on 5th June, on the same basis as hitherto; the indicated production based on the assumption that developments during the remainder of the season will be as unfavourable to the crop as during 1921, 1922, and 1923; the indicated production based on an assumption that later developments will be as favourable to the crop as during 1924 and 1925.—*Reuter's Trade Service.—Times Trade and Engineering Supplement.*

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Although local variations have occurred during the past month the market remains fundamentally unchanged. Slight declines were experienced in all types of sugar during the third and fourth weeks of June, but by 14th July they had recovered their previous level reported in our last issue, namely: Cubes 33*s*., Best Granulated 30*s*., West Indian Crystallized 25*s*. 9*d*. and Muscovado 22*s*. 6*d*., each per cwt., duty paid. Cabled reports of 10th August, record foreign sugar, 96° *c.i.f.* at 11*s*. 10½*d*., preferential, 96° *c.i.f.* at 15*s*. 4½*d*., and Yellow Crystals, landed duty paid, at 25*s*.–26*s*. 6*d*., each per cwt. All these quotations show small but appreciated advances over previous days. In New York, Cuban sugar, 96° *c.i.f.* was quoted at $2.45 per 100 lb. on the same date. Weather reports from the Continental beet areas are exercising an increasing influence upon the market. Futures remain higher than spot prices and although it is difficult to account for it statistically the opinion is widely held that the situation is gradually becoming sounder.

COTTON.—Since our last report prices have shown a sharp reaction from the low point of the season—October 8.44*d*. on 5th July. The advance was the outcome of an oversold market, frightened into covering by reports of insect damage, heavy rains, and lack of fruiting by the plant. The subsequent short covering rapidly advanced prices in a market with a lack of selling power. Middling American sold for 9.90*d*. per lb. on 15th July.

CACAO.—Prices for Ceylon Ordinary, Trinidad Middling Red and Grenada Fine have remained unchanged, since our last issue. Accra Fermented sells well at 50*s*. for ordinary. Cabled advices report Trinidad L.L.T. at 71*s*. to 73*s*. per cwt. and Grenada L.L.T. at 68*s*. per cwt on 10th August. In New York, Trinidad Estates *ex* quay realised 15*c*. per lb. and Grenada Estates *ex* quay 14¼*c*. per lb. (13th August.)

COFFEE.—Owing to the supply not being of a high grade the price of Kenya Good Middling declined from 120*s*. per cwt. to 110*s*. on the 14th July. Jamaica Blue Mountain fell from 210*s*. per cwt. on 30th June to 200*s*. on 14th July. Brazil Santos also shows a 10*s*. drop, having dropped from 120*s*. per cwt. to 110*s*. Costa Rica Middling declined from 165*s*. on 30th June to 160*s*. on 14th July.

TEA.—Prices in general have shown a decline. The latest averages are, Sumatra, 18.81*d*.; Ceylon 18.34*d*.; India 17.93*d*.; Java 14.92*d*.; and Darjeeling 22.37*d*. per lb. respectively.

RUBBER.—Interest in the market has centred on the question of whether average prices for the quarter would be maintained at a price of not less than 1*s*. 9*d*. per lb. in order to avoid the 20 per cent restriction of production in the August-October quarter. Throughout the month the market remained dull. Manufacturers are reported as holding very large stocks of tyres and the continued bad motoring weather in the United States of America has considerably reduced tyre consumption. Stocks everywhere are steadily increasing. The amount of rubber represented by the carry over of unused coupons is unknown and has given rise to some uncertainty. Sufficient enquiry was forthcoming, chiefly from America, to render a reduction in the exportable quota unlikely. Prices on 15th July, included Spot Crêpe 1*s*. 8*d*. to 1*s*. 8¼*d*. and Ribbed Smoked Sheet, Spot, 1*s*. 8¼*d*. to 1*s*. 8⅜*d*.

COPRA.—Prices have shown a slight decline. F.A.Q. Ceylon to London fell from £31 5*s*. per ton on 16th June to £30 15*s*. on 14th July; Sun-dried Straits to Rotterdam from £30 per ton to £29 10*s*. and Straits to Marseilles from £29 per ton to £28 10*s*.

GROUND-NUTS.—A sharp decline has been experienced in the prices of ground-nuts. Nigerian nuts fell from £24 5*s*. per ton to £23 5*s*., while Chinese fell from £23 5*s*. per ton to £22 5*s*.

FERTILISERS.—Sulphate of Ammonia remains at 13*s*. per cwt., Nitrate of Soda fell by 6*d*. to 12*s*. 9*d*. per cwt., while Sulphate of Potash after falling to 11*s*. per cwt. again rose to 11*s*. 3*d*.

PALM KERNELS. — Palm Kernels have experienced a decline in price which has resulted in stimulating enquiries. The decline began on 16th June, when prices reached £21 10*s*. per ton and closed on 14th July, at £20 15*s*.

RICE.—The rises in price recorded in our last issue were well maintained during the remainder of June and even showed some tendency to rise during the first week of July. Subsequently a slight fall took place and prices closed on 14th July at £40 for Carolina and £32 for Patna, each per ton. Burmese, unlike the others has hardened and closed at £16 15*s*. per ton on 14th July.

ADVERTISEMENTS.

MR. HENRY H. R. MOLE, of Little Neck, Long Island, New York, has been appointed advertising agent for *Tropical Agriculture* in the United States of America and Canada. All communications from those countries respecting advertisements should be addressed to him.